Society of Actuaries in Ireland

Winner's Curse: the Competitive Impact of Pricing Uncertainty

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Disclaimer

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Presentation Overview

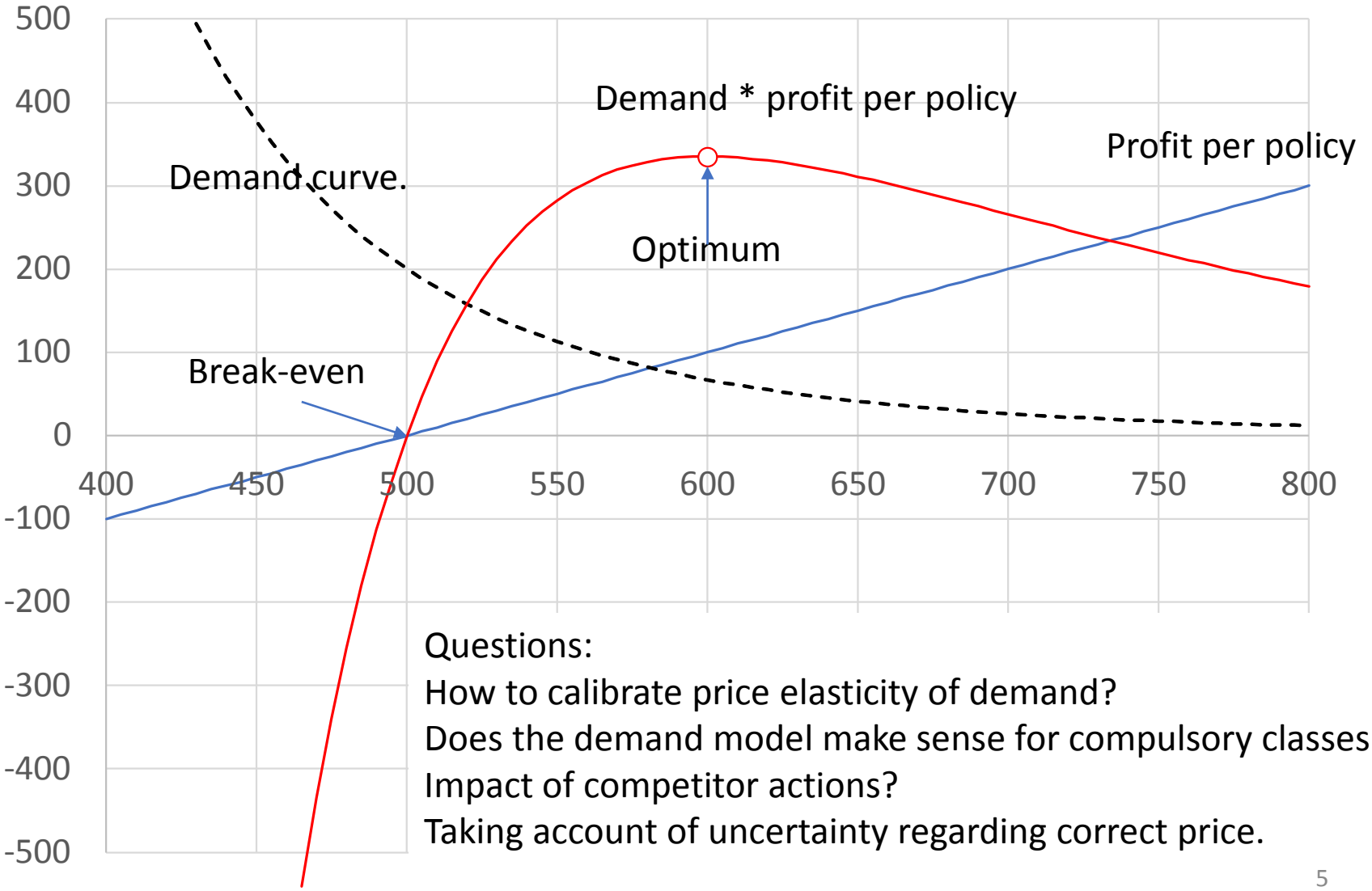
- Pricing scenario: Róisin's Car
- Winner's curse and cost-neutral pricing.
- Optimisation and Nash Equilibrium
- Mergers and Acquisitions
- Conclusions

Pricing Scenario

Róisin needs to insure her car. She calls your company, Amber insurance, for a quote. (She also calls Blue, Chocolate and Dearg for quotes).

- According to your pricing model, the expected cost of Róisin's policy is €500.
  - This includes claims, expenses, taxes, cost of capital.
- What price do you quote?

Textbook Price Optimisation



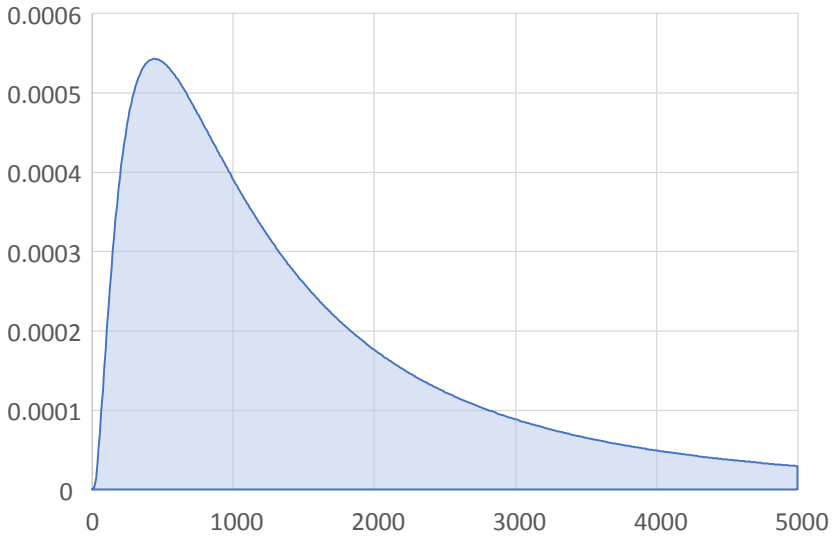
Questions:
How to calibrate price elasticity of demand?
Does the demand model make sense for compulsory classes?
Impact of competitor actions?
Taking account of uncertainty regarding correct price.

Allowing for Competitive Landscape

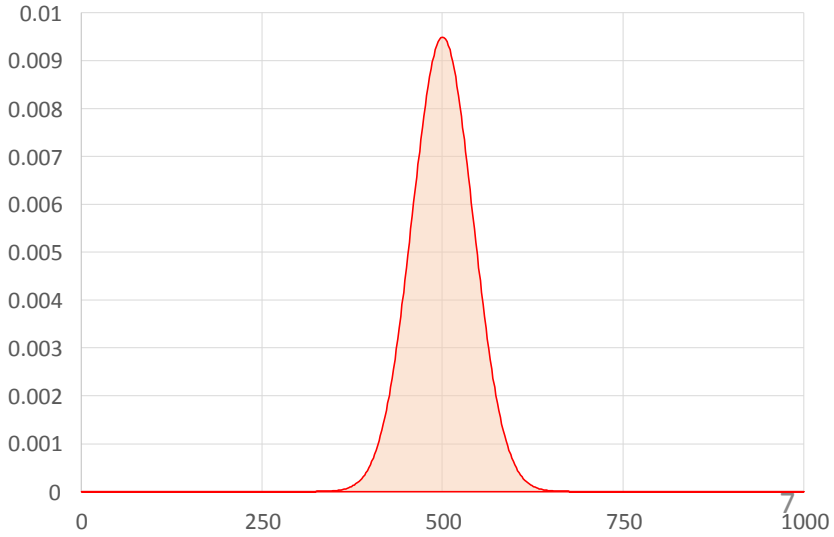
Company	Claim Estimate	Standard Error
Amber	€500	€42
Blue	N/A	€42
Chocolate	N/A	€42
Dearg	N/A	€42

Process & Parameter Error:

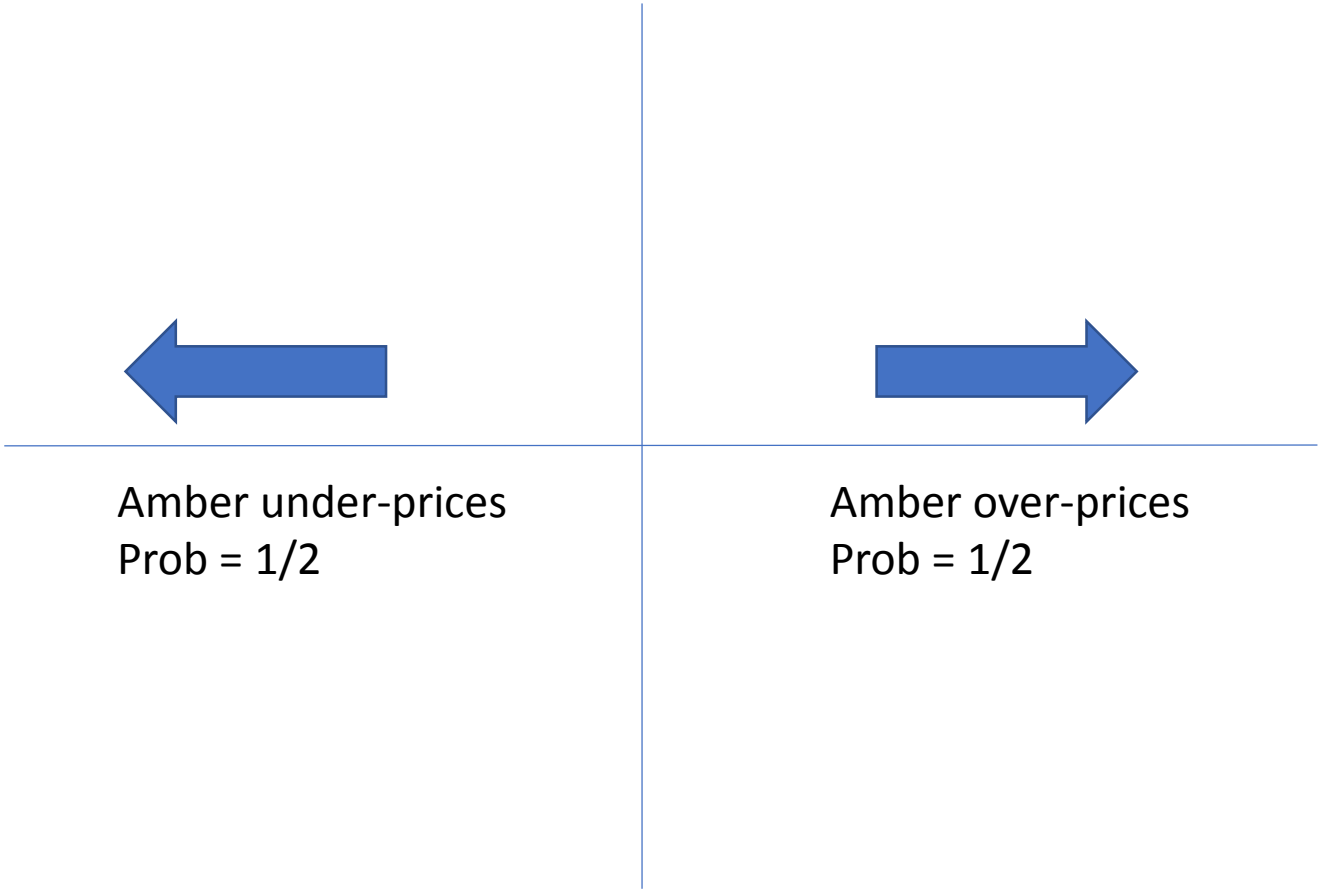
Process Error:
Prob{no claim made} = 0.75
Prob{claim made} = 0.25
E{claim|claim made} = €2000
Claim ~ lognormal.
Relevant for capital, but not for winner's curse.



Parameter Error:
Estimated mean €500
Standard error €42
Relevant for winner's curse because competitors have different data and models.



If Amber prices at Expected Cost:

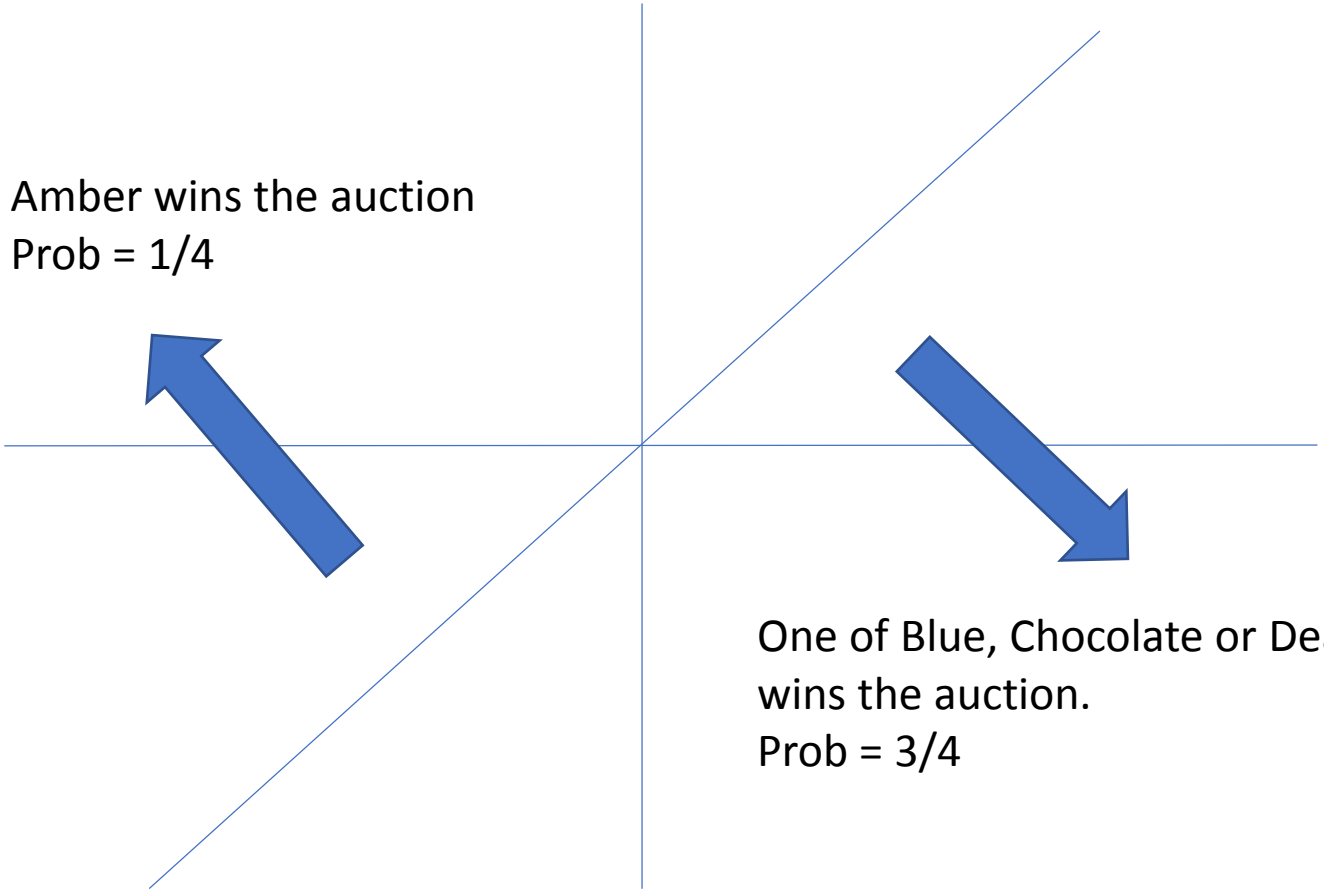


If Competitors Price at Expected Cost

Blue, Chocolate and Dearg
all over-price
Prob = 1/8

At least one of
Blue, Chocolate and Dearg
under-prices
Prob = 7/8

Who wins the auction?



Putting these Together:

Amber under-priced
Min{B,C,D} over-priced
Prob = 4/64

All over-priced
Amber cheapest
Prob = 1/64

All over-priced
Amber not cheapest
Prob = 3/64

Min{B,C,D} under-priced
Amber even cheaper
Prob = 11/64

Amber over-priced
Min{B,C,D} under-priced
Prob = 28/64

Min{B,C,D} under-priced
Amber under-priced,
but not cheapest
Prob = 17/64

Price & Win Rate are Not Independent

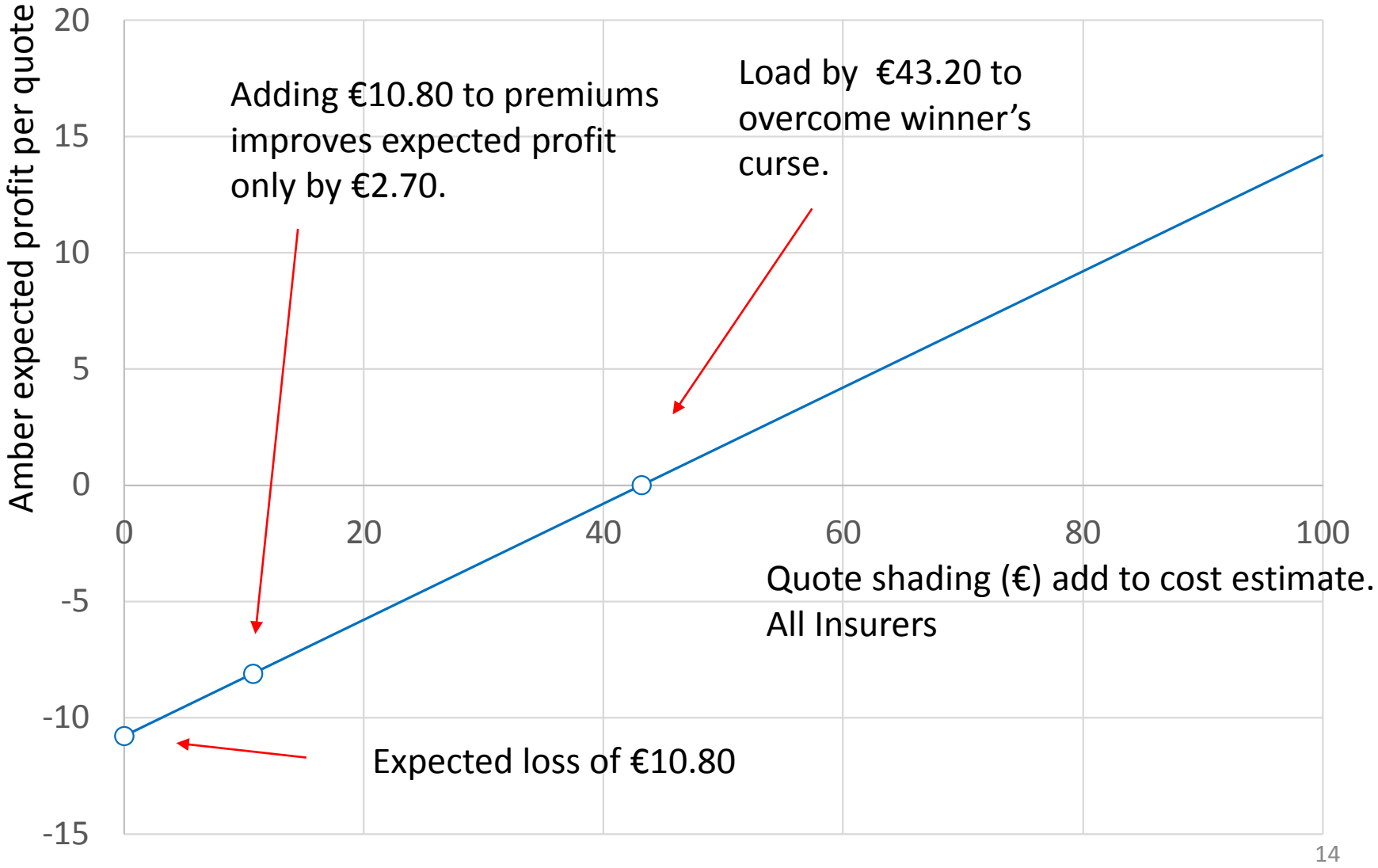
- If everyone prices to break even, then:
  - Prob{A overprices} = 1/2
  - Prob{A wins auction} = 1/4
  - Prob{A overprices and wins auction} = 1/64
  - Prob{A overprices | A wins auction} = 1/16
  - Prob{A wins auction | A overprices} = 1/32
- Which probabilities matter for pricing?
  - For the rest of this presentation, I use unconditional probabilities.
  - In contrast, industry profit tests typically per policy
    - ie probability conditional on winning
  - Beware of high profit per policy but very low win rate.

Amber's Expected Loss

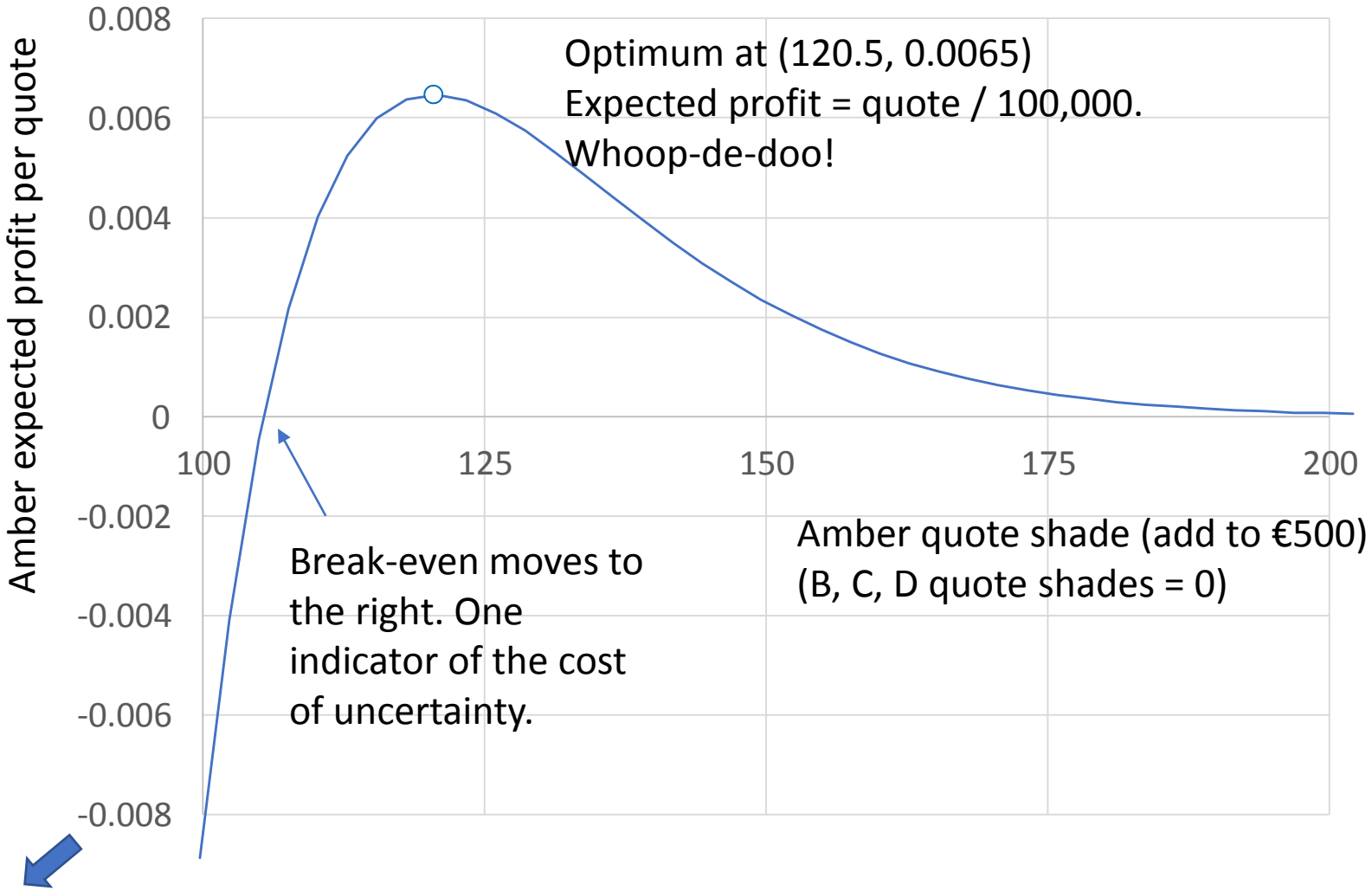
- Allowing for Winner's Curse, Amber expects to make a loss of €10.80 per quote.
- We can work this out by Monte Carlo.
  - Start with a guessed of μ, the true mean
  - Generate Z_A, Z_B, Z_c, Z_D independent $N(0, 42^2)$
  - Insurer j quotes $\mu - Z_j$ (for $j = A, B, C, D$)
  - Cheapest insurer loses Z_j; others make no profit or loss.
  - Repeat a million times and take the average Amber loss.
  - Answer doesn't depend on what μ we started with.
- We can also calculate analytically:.

$$\frac{€10.80}{€42} = \frac{3\tan^{-1}\sqrt{2}}{2\pi^{3/2}}$$

Cost-Neutral Winner's Curse Quote Shading

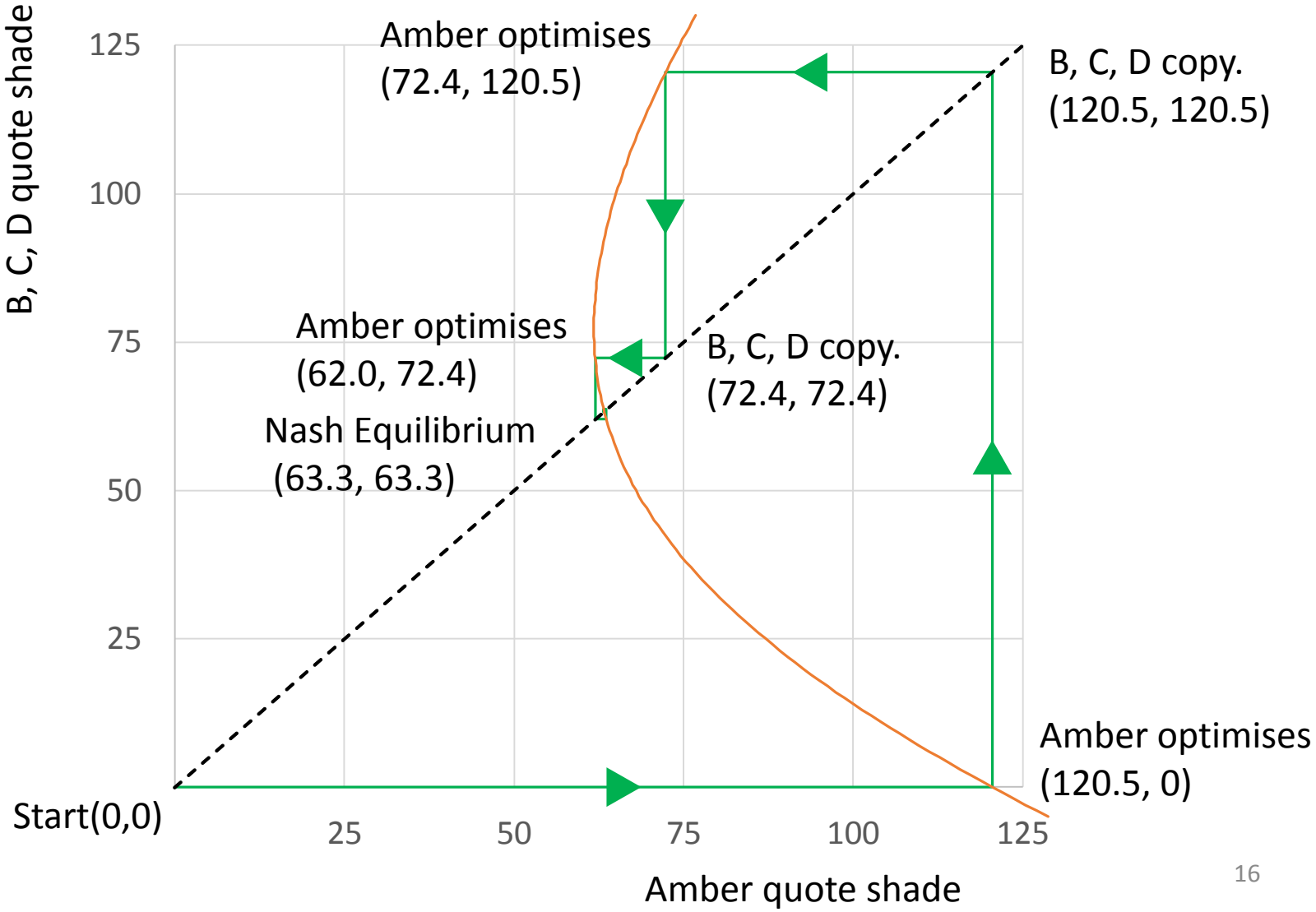


Optimisation Allowing for Winner's Curse



(0,-10.8) remember winner's curse of €10.8

Suppose Everyone Copies Amber's Loading

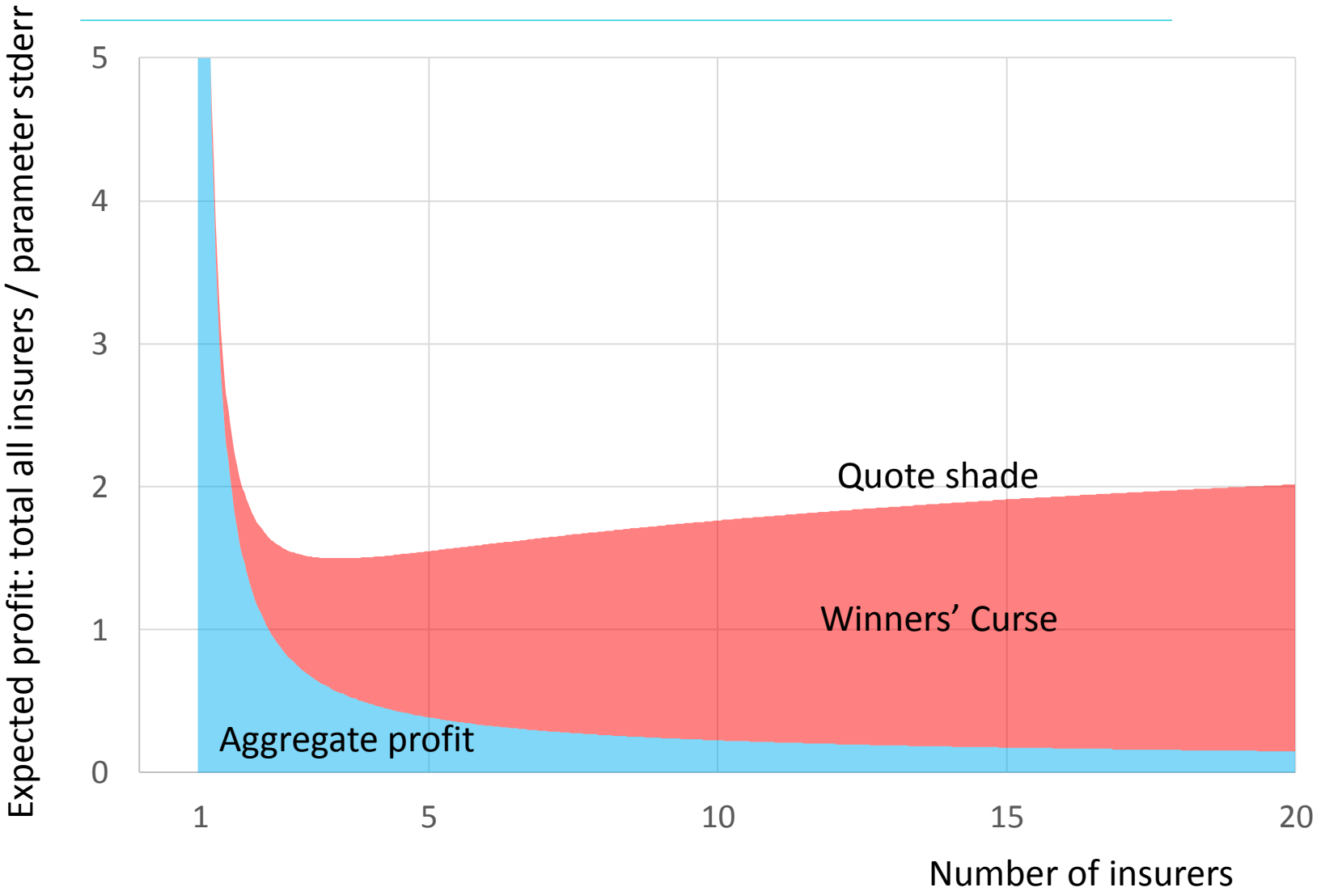


Nash Equilibrium

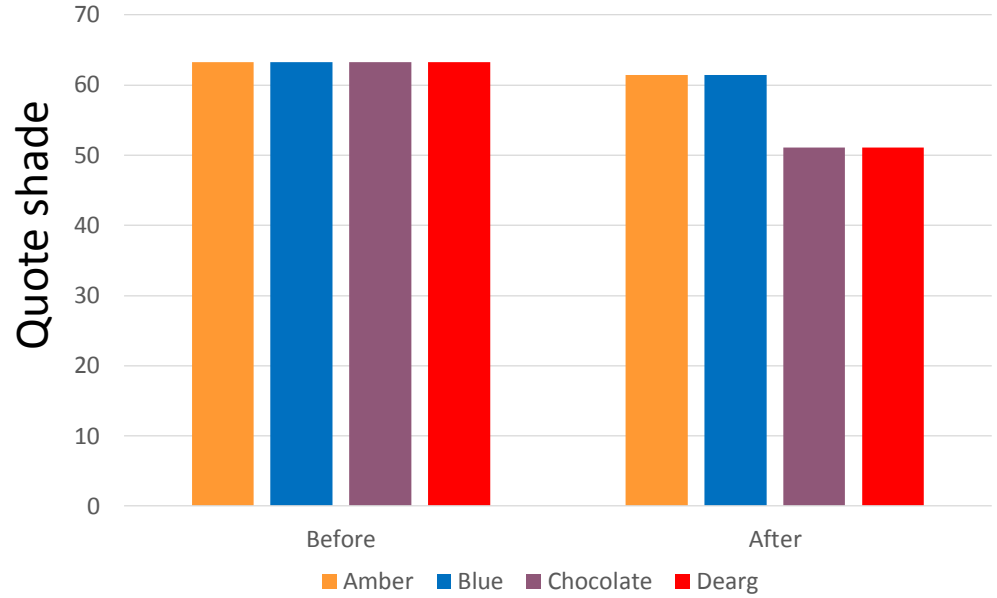
- Nash equilibrium applies when all insurers know each other's quote shading (but not each other's cost estimates)
- In this case, equilibrium quote shading = €63.30
- Expected profit (per quote) = 63.3/4 – 10.8 = €5.02
- Expected profit (per policy) = €20.06
- Can also compute the equilibrium analytically

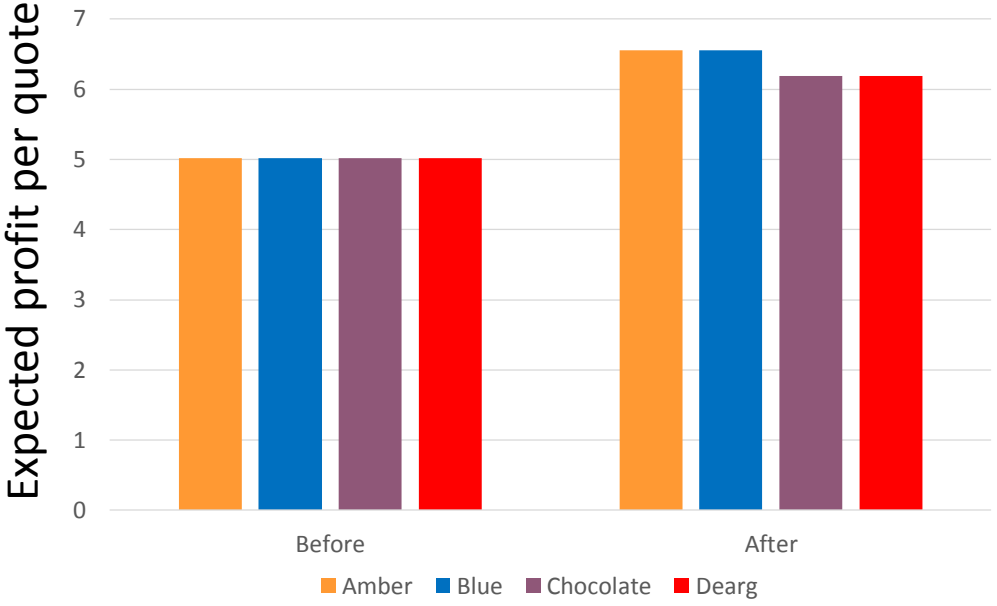
$$\frac{63.3}{42} = \frac{\pi^{3/2} + \sqrt{3\pi}}{6 \tan^{-1} \sqrt{2}}$$

Competition and Profit Margin



Merger of Chocolate and Dearg





In this experiment, Chocolate+Dearg pool their cost estimates, so new stderr = 42/√2

The merged entity has more accurate cost estimates so can reduce price shading.
Amber and Blue reduce price shading slightly as competition reduced.

Amber, Blue and Chocolate+Dearg are all more profitable than they were before.

However, Amber and Blue benefit more than Chocolate+Dearg from the removal of ill-informed competitors.

Róisin loses through higher prices.

Conclusions

- Winner's curse arises:
  - in a competitive pricing situation
  - if other sellers have access to superior information.
- Allowance currently implicit in most pricing models.
- Explicit approaches: Cost Neutral or Nash Equilibrium.
- Price elasticity of demand is a consequence of competitor pricing models and not a policyholder attribute.
- Investigate consequences of mergers, new entrants and other market structure changes.
- Build a business case for additional data or better analysis.

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